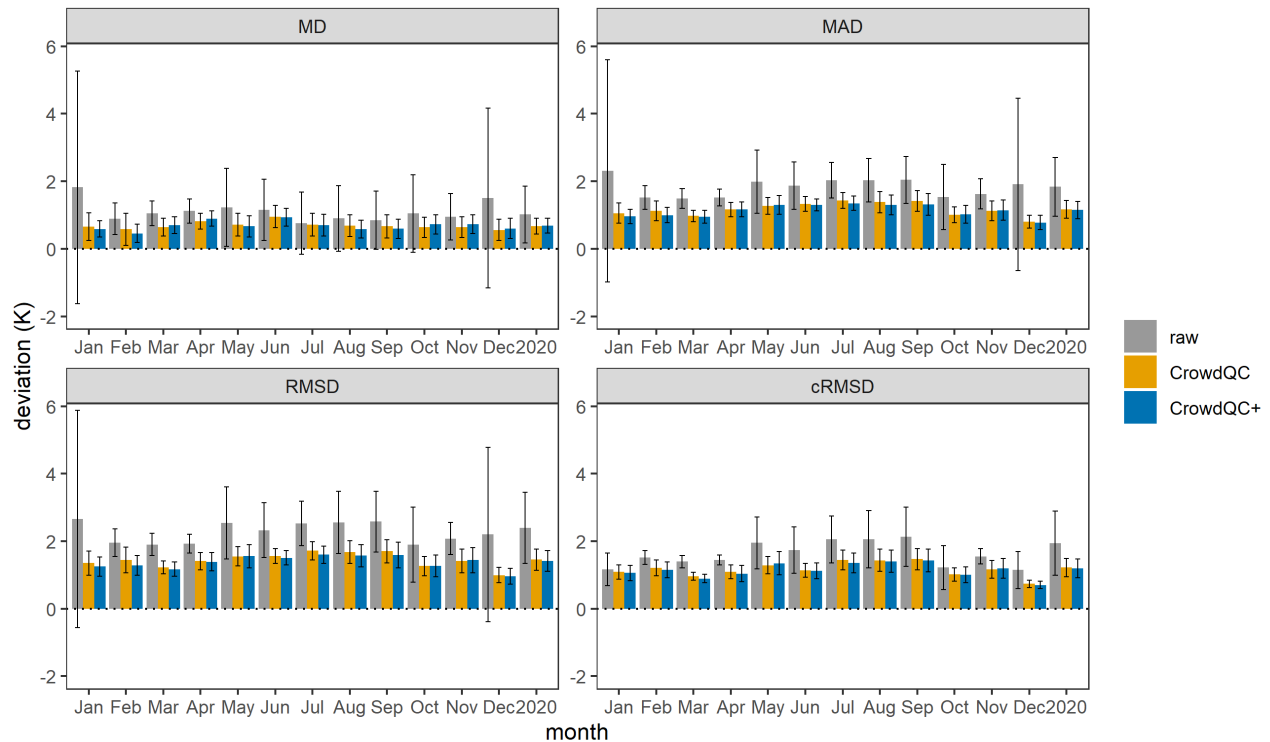


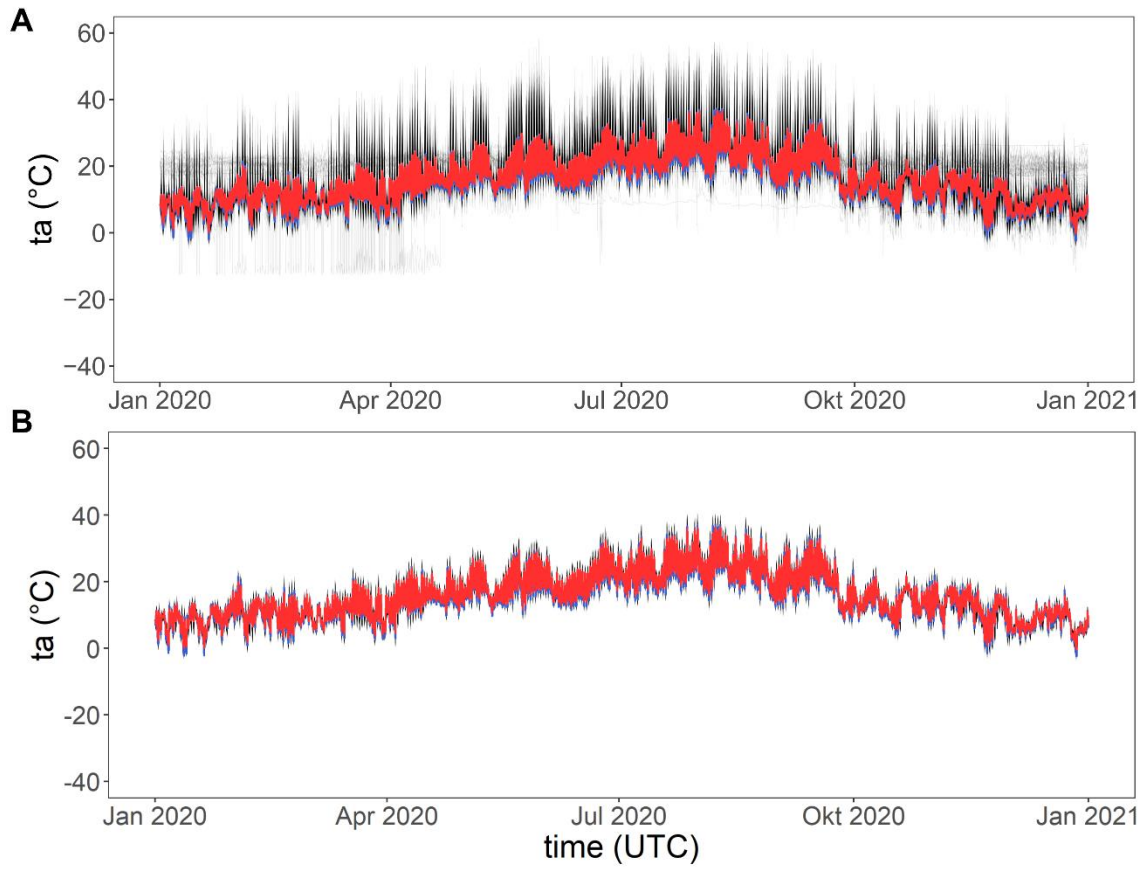
Supplementary Material

1 Supplementary Figures and Tables

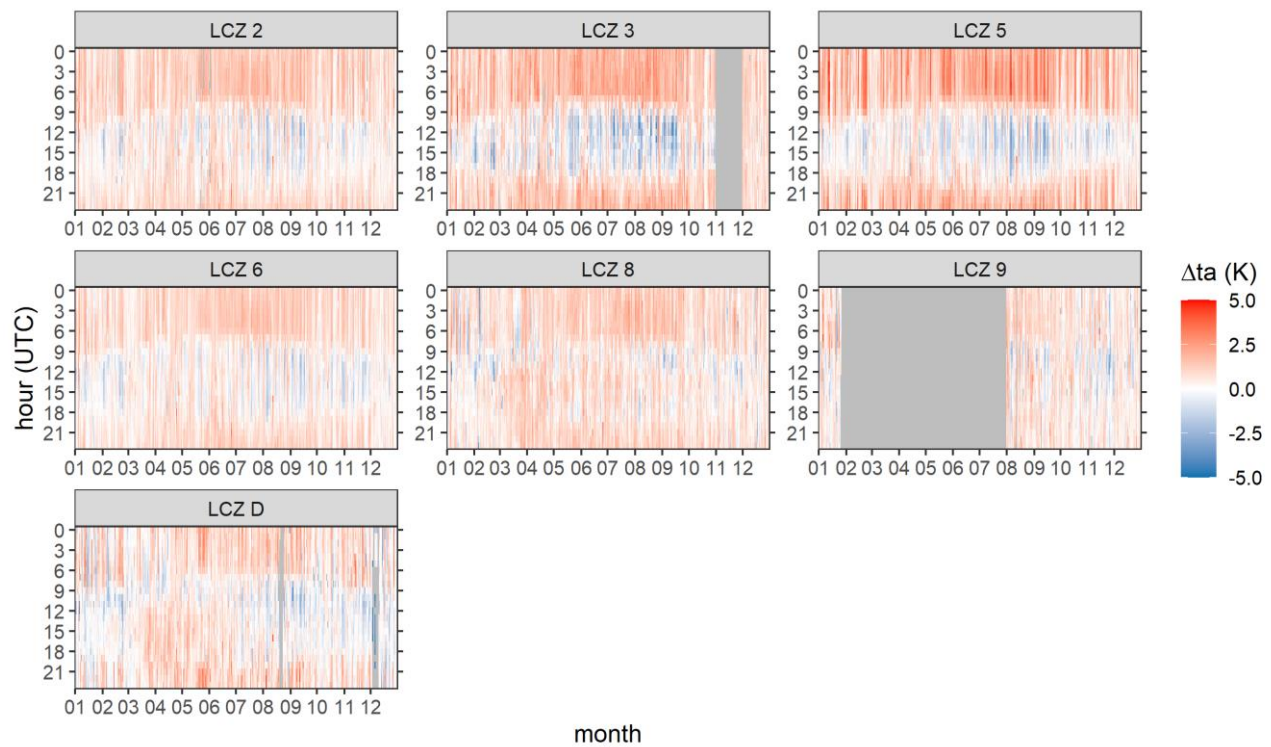
1.1 Supplementary Figures



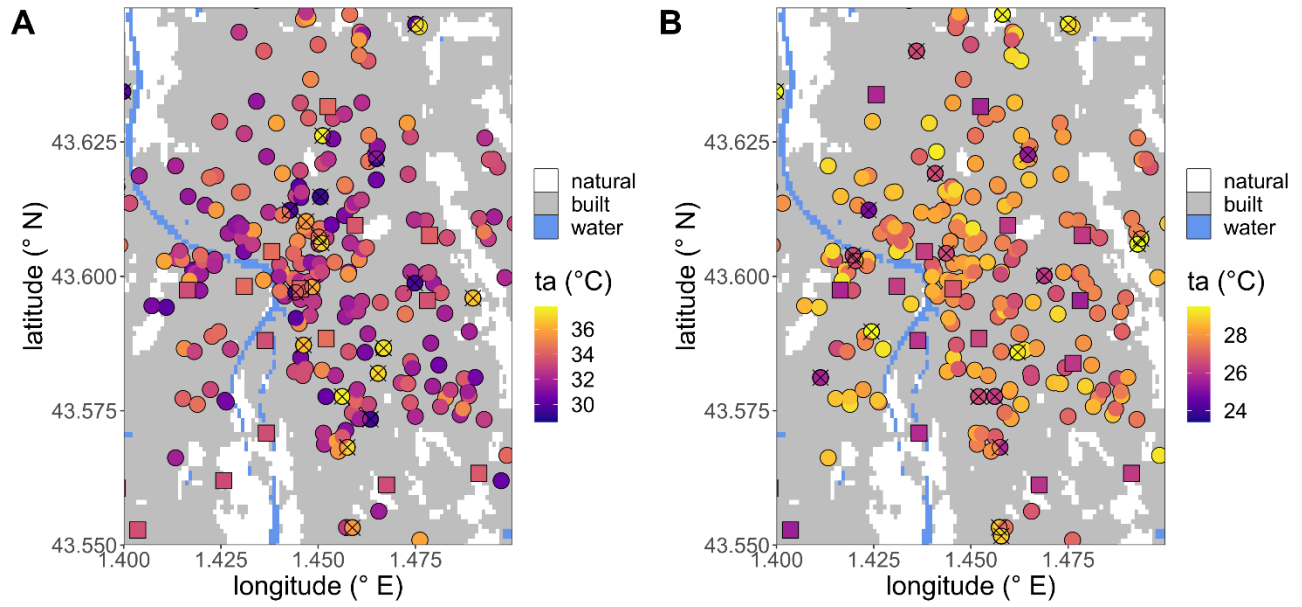
Supplementary Figure 1. Deviations in hourly air temperature (t_a) between CWS and PRWS in Toulouse during 2020 per month and for the whole year. Displayed are values for the raw data set, after applying CrowdQC and CrowdQC+ in their respective default settings (cf. Table 2). Shown are values at QC level o3. Deviations were calculated between each PRWS and each CWS within a radius of 2000 m around the respective PRWS, located in the same LCZ type as the PRWS. Deviations were then averaged per month and year across all CWS and PRWS. Error bars denote the standard deviation across all CWS and PRWS per month and year. MD: mean deviation, MAD: mean absolute deviation, RMSD: root-mean-square deviation, cRMSD: centred RMSD.



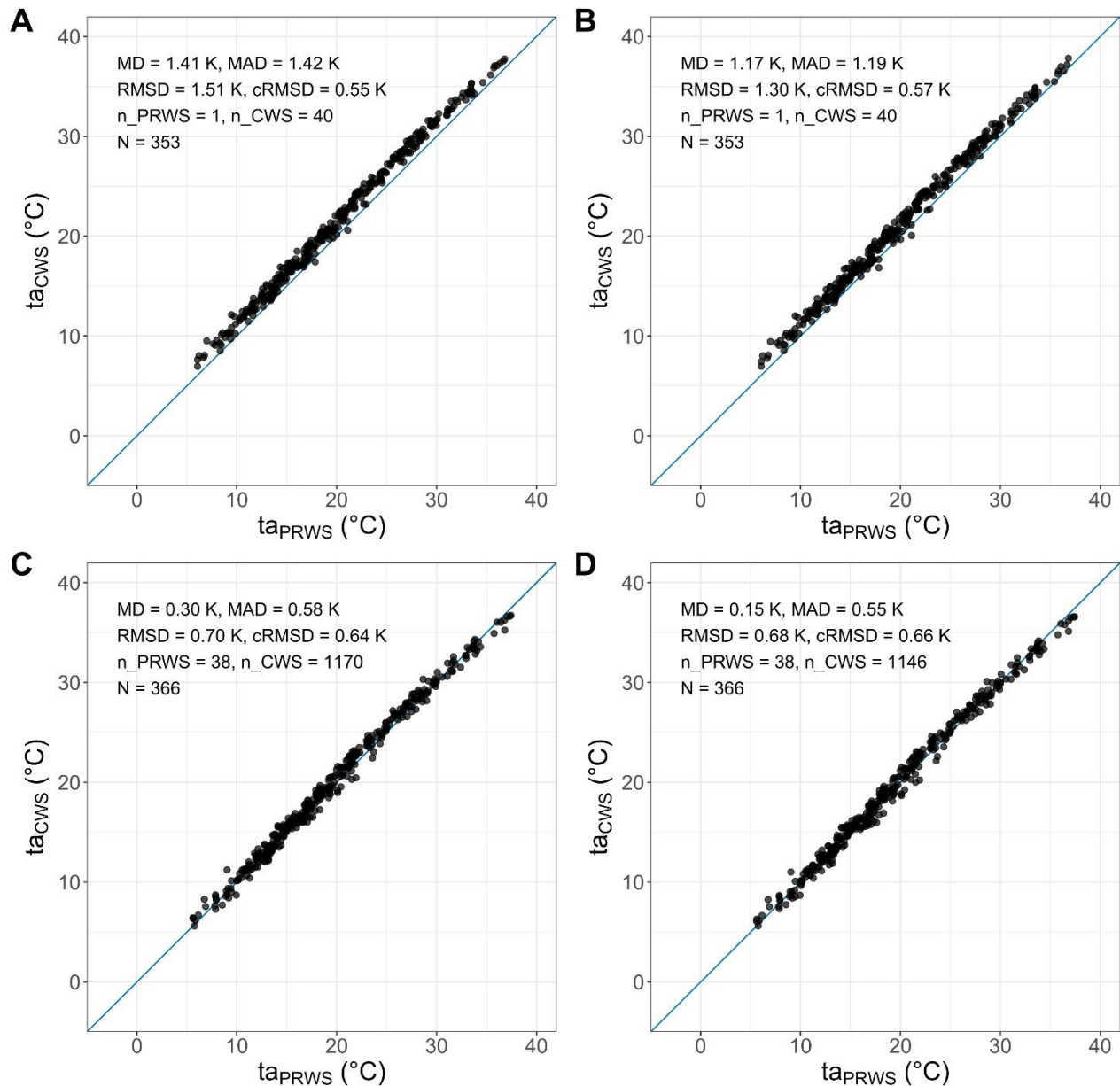
Supplementary Figure 2. Hourly air temperature (ta) in Toulouse during 2020. Each grey line corresponds to data from a single CWS, the red line displays the spatial median across all CWS, the blue line the median across all PRWS. Sub-figure (A) shows raw CWS data, sub-figure (B) CWS data at QC level m5 of CrowdQC+ with default settings (cf. Table 2).



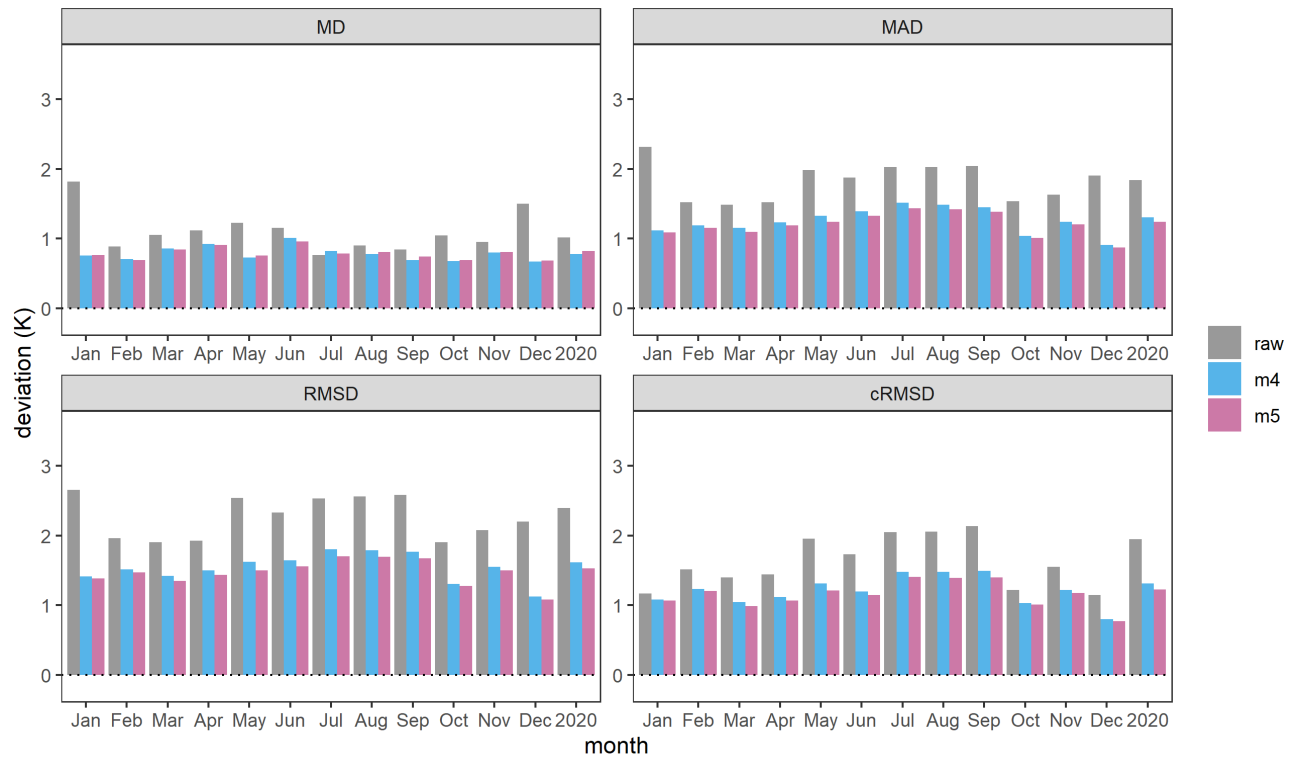
Supplementary Figure 3. Hourly air-temperature difference (Δta) between mean CWS and mean PRWS ta in Toulouse per Local Climate Zone LCZ during 2020. CWS data at QC level m5 after CrowdQC+ with default settings (cf. Table 2). CWS and PRWS data were averaged across all stations in the respective LCZ. Missing episodes are displayed in grey.



Supplementary Figure 4: Air-temperature (ta) distribution in central Toulouse for (A) 31 July 2020 13:00 UTC and (B) 01 August 2020 01:00 UTC as measured by CWS (circles) and PRWS (squares). CWS data are displayed at QC level m4, crosses mark values that were removed in QC level m5 (radius: 3000 m, minimum number of buddies: 5, alpha: 0.1). Note the different colour scales in the two subplots. Underlying landcover derived from the LCZ map (natural: LCZs A-F, built: LCZs 1-10, water: LCZ G).



Supplementary Figure 5. Relation between daily maximum air temperature (ta) at PRWS and CWS in Toulouse during 2020. (A) and (B) for one PRWS (station “Carmes”; 43.59769° N, 1.44544° E) and the mean of all CWS within a 2000 m radius around the PRWS in the same LCZ type (2 – compact midrise). (C) and (D) as the mean across all PRWS and all CWS. (A) and (C) display CWS ta at QC level m4, (B) and (D) CWS ta at QC level m5. MD: mean deviation, MAD: mean absolute deviation, RMSD: root-mean-square deviation, cRMSD: centred RMSD, n_PRWS: number of PRWS, n_CWS: number of CWS, N: number of daily values.



Supplementary Figure 6. Deviations of hourly air temperature (t_a) between CWS and PRWS in Toulouse during 2020 per month and for the whole year for raw data, QC levels m4, and m5. Deviations were calculated between each PRWS and each CWS within a radius of 2000 m around the respective PRWS, located in the same LCZ type as the PRWS. Deviations were then averaged per month and year across all CWS and PRWS. MD: mean deviation, MAD: mean absolute deviation, RMSD: root-mean-square deviation, cRMSD: centred RMSD.

1.2 Supplementary Tables

Supplementary Table 1: Mean annual deviations in hourly air temperature (*ta*) and in aggregated daily values of mean (*ta_mean*), maximum (*ta_max*), and minimum (*ta_min*) between CWS and PRWS in Toulouse, and remaining data availability during 2020 after applying CrowdQC+ in its default setting (cf. Table 2). Displayed are values at QC level o3 with different ‘durations’ (in QC levels m3, m4, o3). Bold values mark best results per metric and variable, italic values second best. Deviations were calculated between each PRWS and each CWS within a radius of 2000 m around the respective PRWS, located in the same LCZ type as the PRWS. Deviations were then averaged across all CWS and PRWS. MD: mean deviation, MAD: mean absolute deviation, RMSD: root-mean-square deviation, cRMSD: centred RMSD.

Metric	Variable	3 days	7 days	14 days	21 days	1 month	complete
MD (K)	<i>ta</i>	0.71	<i>0.68</i>	0.70	<i>0.68</i>	<i>0.68</i>	0.63
	<i>ta_mean</i>	0.68	0.66	0.66	<i>0.65</i>	0.66	0.61
	<i>ta_max</i>	-0.11	-0.19	-0.19	<i>-0.16</i>	-0.21	-0.24
	<i>ta_min</i>	1.52	<i>1.50</i>	1.53	1.51	1.57	1.48
MAD (K)	<i>ta</i>	1.14	1.12	1.14	<i>1.12</i>	1.15	1.11
	<i>ta_mean</i>	0.78	<i>0.75</i>	0.76	0.76	0.76	0.73
	<i>ta_max</i>	0.98	0.99	0.97	<i>0.95</i>	0.94	0.99
	<i>ta_min</i>	1.56	1.55	1.56	<i>1.54</i>	1.60	1.51
RMSD (K)	<i>ta</i>	1.40	1.38	<i>1.39</i>	1.38	1.42	1.38
	<i>ta_mean</i>	0.90	<i>0.88</i>	0.89	<i>0.88</i>	<i>0.88</i>	0.87
	<i>ta_max</i>	1.21	1.23	<i>1.20</i>	1.18	1.18	1.27
	<i>ta_min</i>	1.72	<i>1.71</i>	1.72	<i>1.71</i>	1.77	1.69
cRMDS (K)	<i>ta</i>	1.15	<i>1.16</i>	<i>1.16</i>	1.15	1.19	1.20
	<i>ta_mean</i>	0.52	0.52	0.52	0.52	<i>0.53</i>	0.57
	<i>ta_max</i>	0.96	0.98	0.99	0.96	0.98	1.11
	<i>ta_min</i>	<i>0.73</i>	<i>0.73</i>	0.70	0.74	0.77	0.76
Data availability	% of raw data	38.4	35.0	31.8	29.9	29.5	14.8
	No. of CWS	1043	951	864	765	700	147

Supplementary Table 2: Mean annual deviations in hourly air temperature (ta) and in aggregated daily values of mean (ta_mean), maximum (ta_max), and minimum (ta_min) between CWS and PRWS in Amsterdam (2019) and Toulouse (2020) after applying CrowdQC+ in its default setting (cf. Table 2). Displayed are values at QC level o3 without (ta_int) and with (ta_corr) time-constant correction, using a time constant of 1480.5 s. Deviations were calculated between each PRWS and each CWS within a radius of 2000 m around the respective PRWS, located in the same LCZ type as the PRWS. Deviations were then averaged across all CWS and PRWS. MD: mean deviation, MAD: mean absolute deviation, RMSD: root-mean-square deviation, cRMSD: centred RMSD.

Metric	Variable	Amsterdam		Toulouse	
		ta_int	ta_corr	ta_int	ta_corr
MD (K)	ta	0.28	0.28	0.68	0.69
	ta_mean	0.26	0.26	0.66	0.66
	ta_max	0.45	0.53	-0.21	-0.14
	ta_min	0.32	0.29	1.57	1.54
MAD (K)	ta	0.70	0.70	1.15	1.13
	ta_mean	0.55	0.55	0.76	0.76
	ta_max	0.88	0.94	0.94	0.97
	ta_min	0.68	0.68	1.60	1.57
RMSD (K)	ta	0.92	0.93	1.42	1.40
	ta_mean	0.67	0.67	0.88	0.88
	ta_max	1.14	1.23	1.18	1.22
	ta_min	0.82	0.82	1.77	1.75
cRMSD (K)	ta	0.78	0.79	1.19	1.17
	ta_mean	0.48	0.48	0.53	0.53
	ta_max	0.91	0.97	0.98	1.01
	ta_min	0.54	0.54	0.77	0.77